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OSCILLATING WEIGHT

The present invention concerns automatic watches. It relates more particularly to oscillating weights.

Automatic watches comprise a movement fitted with a time base, a gear train synchronised by the time base, an energy accumulator, generally a barrel, powering the time base and driving the gear train, and an automatic mechanism supplying energy to the energy accumulator.

Conventionally, this mechanism comprises an oscillating weight, pivotably mounted on the frame of the movement by means of a bearing, a reverser converting the alternating movement of the weight into a rotational movement in one direction, and a winding train, which is of the reduction train type, driven by the reverser. The oscillations of the weight, generated by the movements of the person wearing the watch, thus drive in rotation the winding train, which cooperates with the barrel to wind its spring.

The oscillating weight is arranged to carry a bearing, for example a ball bearing, which defines an axis of rotation. It comprises a mass member whose centre of gravity is shifted with respect to the axis of rotation. The mass member is generally designed so as to generate maximum torque. It is made of a heavy material, frequently gold or platinum in top of the range watches. At its periphery, it includes a sector of inertia defining the important part of its weight, and a plate connecting the sector to the bearing.

The oscillating weight generates torque essentially as a function of the weight of the sector and the position of its centre of gravity, with reference to the axis of rotation. This torque is applied to the first wheel set of the winding train via the reverser. The reduction rate of the gear train forming the winding train defines the torque finally applied to the barrel spring.

When the person wearing the watch is a calm person, arm movements unpoise the weight and it is the terrestrial acceleration g which defines the torque. If the person is very active, the accelerations encountered can be substantially greater. Currently, winding mechanisms are chosen so as to provide spring winding conditions for a normally active person. Consequently, with a very active person, the barrel spring is

greatly taxed and the risk of excessive wear cannot be ruled out. If, conversely, the person wearing the watch is very calm, the spring barrel is not wound sufficiently.

It is an object of the present invention to allow peculiarities of the person wearing the watch to be taken into account in order to improve winding conditions. Therefore, the mass member includes:

- two parts that can be moved in relation to each other, and arranged such that their relative movement causes a radial movement of the centre of gravity of the mass member, and
- a securing device, cooperating with the first and second parts, capable of occupying a first state in which said parts can be moved with reference to each other, and a second state in which said parts are rigidly secured to each other.

Owing to the fact that the two parts can be moved in relation to each other and with them, the centre of gravity of the weight, it is possible to vary the working conditions of the mechanism and thus adapt it to the user's way of life.

Advantageously, the first part of the oscillating weight further comprises a plate, arranged for carrying the bearing, and a sector of inertia. This plate extends from the centre, which is provided with a hole in which the bearing is engaged, towards the periphery which carries the sector of inertia. Certain weights comprise an added sector of inertia, while others are made in one piece.

In a first embodiment, the second part is formed of at least one inertia block pivotably mounted on the sector. Moreover, the securing device includes indexing means arranged for positioning the inertia block in a finite number of predefined positions in which the securing device holds the inertia block when it is in its second state, whereas it allows passage from one of these positions to another when it is in its first state.

In order to increase the correction range and/or the accuracy of such correction, the second part comprises two inertia blocks.

In a variant allowing a high level of adjustment precision, one of the inertia blocks can occupy a finite number <u>n</u> of positions defined such that the passage of said inertia block from one of the positions to another causes a radial movement of the centre of gravity of a value ΔG, and so that the second inertia block is arranged so as to be able

to occupy a number m of positions where the passage from one position to another causes a radial movement of the centre of gravity of a value Δg, said inertia blocks being arranged such that the product $m.\Delta g$ is substantially equal to ΔG. Consequently, it is possible to define m.n adjustment positions, without the indexing means becoming too complex.

In this embodiment, the moment of inertia of the weight decreases with the torque being generated.

In a second embodiment, the second part of the weight also includes a plate and a sector of inertia, disposed side by side respectively with the plate and the sector of the first part. Moreover, the securing device is arranged so as to allow a relative movement of the second part with reference to the first part by rotation about the axis of the oscillating weight.

Other advantages and features of the invention will appear from the following description, made with reference to the annexed drawing, in which:

- Figures 1 and 2 show oscillating weights, in accordance, respectively, with a first embodiment and a second embodiment of the invention, seen from above at a, in cross-section at b, and blown up at c.

The weight shown in Figure 1 includes a plate 10 comprising a central portion 10a of generally annular shape, provided with a central aperture 10b for receiving a bearing 12 that is partially shown, for example a ball bearing, and arms 10c extending radially outwards. The central aperture 10b is circular, defined by a circle of axis A-A.

In its central portion 10a, plate 10 carries, arranged in a ring, threaded pins 13 for securing bearing 12 by means of bolts 14.

At their periphery, arms 10c are connected by an annular centre portion 10d disposed on axis A-A. It is provided with three holes in which screws 16a are engaged.

A sector of inertia 18, in the form of an annular portion, is provided with five threaded feet 20. It is secured to plate 10 by means of screws 16a engaged in three of threaded feet 20. It is advantageously made of a heavy material, for example gold or platinum in

top of the range watches, of brass for more common products. It extends over an angle of approximately 180°. The function of the two other threaded feet 20 will be specified hereinafter.

Plate 10 is only secured to sector 18 over an angle of approximately 90°, via its annular portion 10d. The edges of arms 10c connecting central portion 10a to annular portion 10d are also in the arc of a circle, the centres of which are each at one of the ends of sector 18, identical to the centres of the two other threaded feet 20. These edges each carry six regularly distributed threaded feet 22.

One of inertia blocks 24 is mounted on each of end feet 20. They have the general shape of a sector of a circle and include, at the apex 24a of the sector, a cylindrical hole in which threaded foot 20 is engaged, and a screw 16b for axial holding. The opposite side is provided with a finger 24b including an aperture to be engaged in one or other of threaded feet 22. A nut 26 is screwed onto foot 22 in order to hold inertia block 24 via its finger 24b.

In this oscillating weight, the sector of inertia 18 and plate 10 form a first part of a mass member, and inertia blocks 24 a second part, the centre of gravity of said member being located at G. Screws 16, threaded feet 20 and threaded feet 22, and nuts 26 act as the securing device, which, depending upon whether its constituent parts are in an unscrewed or screwed state, allows or prevents the movement of inertia blocks 24 with reference to sector of inertia 18 and plate 10. Moreover, the threaded feet index inertia blocks 24, so that the latter can occupy a determined number of positions.

With the weight thus described, it is possible to vary by several percent the torque that it applies to the gear train in order to rewind the motor spring of the watch. The position of one or other of the two inertia blocks 24 has only to be altered. The centre of gravity G is shifted further with respect to axis A-A and, consequently, the torque is greater when the ends fitted with finger 24b of inertia blocks 24 are in proximity to sector 18. Conversely, by returning finger 24b so that it is engaged in a foot 22 close to central portion 10a, the centre of gravity if shifted towards axis A-A, so that the torque is reduced.

Any horologist trained for this purpose can adjust the torque. In order to guarantee optimum working conditions, a first adjustment can be made when the watch is sold, by classifying the person that it is for with reference to his or her physical activities,

both professional and leisure activities. On this basis, the instructions for the watch define the position in which the inertia blocks should be located. After several days wear, it is possible to check whether the position selected is correct. In order to carry out the adjustment, one has only to unscrew screws 16b and nuts 26 to be able to move inertia blocks 24, then screw them back in again when inertia blocks 24 are in the chosen position.

In order to make the most accurate adjustment possible, one could envisage using inertia blocks that do not have the same features. One of them can occupy a finite number n of positions defined such that passage from one position to another generates a radial movement of the centre of gravity of a value ΔG. The second inertia block is arranged so as to be able to occupy a number m of positions where passage from one position to another generates a radial movement of the centre of gravity of a value Δg. The inertia blocks are sized such that the product $m.\Delta g$ is substantially equal to ΔG. Consequently, an accurate correction can be made.

The embodiment described hereinbefore has to be only slightly altered in order to achieve this result. The dimensions (thickness, length particularly) of one of the inertia blocks have only to be reduced in an appropriate manner to obtain the desired effect. This operation is easily accessible to those skilled in the art.

Adjustment can occur particularly easily in a watch fitted with a power reserve. Then, one only needs to establish a correlation between the movement of the inertia blocks and the degree of winding of the spring.

In the embodiment described with reference to Figure 1, the moment of inertia increases at the same time that the centre of gravity of the weight is moved. It is also possible to change the position of the centre of gravity while keeping the same moment of inertia. This is permitted by the embodiment shown in Figure 2, which shows a weight shown in plan at a and in cross-section at b and blown up at c.

This weight includes first and second parts 32 and 34 each including a plate and a sector of inertia, respectively referenced 36 and 38 for the first part 32 and 40 and 42 for the second part 34.

Plates 36 and 40 have the general shape of a sector of a circle, with an apex angle of approximately 45°. The apex part is cut to form an annular portion identified by the

letter a, covering an angle of approximately 200° for portion 36a and approximately 90° for portion 40a, as can be seen in Figure 2c. These portions are pierced with holes identified by the letter b, three oblong holes in portion 36a and two cylindrical holes in portion 40a.

The two plates are assembled to each other by means of a securing device comprising a tightening ring 44 provided with threaded holes 44a, and arranged below portions 36a and 40a, a cover 46 placed above portions 36a and 40a, provided with cylindrical holes 46a aligned on holes 44a, and screws 48 freely engaged in the holes of cover 46 and annular portions 36a and 40a, and tightened in threaded holes 44a of tightening ring 44.

Since plate 36 is provided with oblong holes, it is possible to move it angularly with reference to plate 40, about an axis corresponding to the pivoting axis A-A of the weight, if screws 48 are unscrewed.

Plates 36 and 40 are each pierced with three holes identified by the letter c, made at the periphery of the sector of the circle. Their function will be specified hereinafter.

Sectors of inertia 38 and 42 each include an annular portion, identified by the letter a and covering an angle of approximately 80°, and a shoulder b attached to the annular portion a in its concave part. Shoulder b, which extends over approximately 45, acts as a support for the plate. It is provided with two cylindrical holes, identified by the letter c, in which are engaged, for each of them, a tightening stud 50, which is provided with a threaded hole. Two screws 52 are engaged in two of holes c of plates 36 and 40 and in studs 50 in which they are tightened. Plates 36 and 40 are, consequently, respectively secured to sectors 38 and 42.

In a variant, sectors 38 and 42 could also be integral respectively with plates 36 and 40, or welded to each other.

With the structure that has just been described, it may happen that plates 36 and 40 lack rigidity. Thus, in order to better secure the two parts to each other, the securing device further includes a stiffening arm 54, in the form of an annular portion covering an angle of approximately 90°, disposed in the extension of shoulders 38b and 42b. This arm includes two oblong apertures 54a each disposed facing the third hole of the plates. A screw 56, cooperating with a nut 58, is engaged in each of these holes and in

holes 36c and 40c that are not occupied by screws 52, such that, by tightening the screw and its nut, it is possible to secure the two parts rigidly to each other.

Numerous variants of the two embodiments described hereinbefore can of course be envisaged. The solutions described largely rely on screws, which is a particularly simple solution to implement for making single pieces or prototypes. In the case of large-scale manufacture, one could envisage using other locking systems, for example snap-fit systems, or any other means known to those skilled in the art. The two constituent parts of the weight could also have very different shapes, and have dimensional ratios that vary considerably, as a function of the relative movement possible and the desired range of adjustment.

It would also be possible to design a weight in accordance with the second embodiment fitted with an inertia block as defined in the first embodiment, so as to allow a rough adjustment with relative movement of the two parts, then a finer adjustment by adjusting the position of the inertia block.

Thus, owing to the fact that the weight according to the invention has two parts that are mobile with reference to each other, their movement inducing a change in radial position of its centre of gravity, it is possible to optimise the working conditions of automatic watches and thus obtain optimum yield for a minimum volume, whatever the conditions imposed by the person wearing the watch.